RoboCupRescue Robot League 2022

Qualification Document

Version 20220208

Subject to change, please visit our website for the most up-to-date version.

https://rrl.robocup.org

League Organization

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Adam Jacoff (Emeritus 2009-2015) (Co-Founder)
Satoshi Tadokoro (Emeritus (2002-2008) (Co-Founder)

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League Organization

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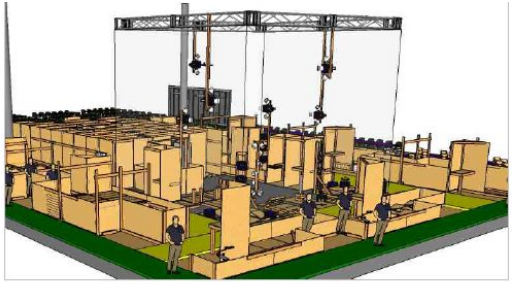


Qualification Process

For in-person competition:

- Team Participation Form (https://rrl.robocup.org/forms-guides-labels/) to declare intent to participate (**NOW**).
  - See https://rrl.robocup.org/forms-guides-labels/ for TPF and TDP details.
- Team Description Paper (TDP) describing their entry (March 4th).
  - Most teams will need to include videos of their robot doing tests from at least different 2 suites.
  - There will be a **best** TDP award. You may update your TDP for the best TDP award at any time up until June 27th.
- Regions with many teams should go to the local Regional Open, from which the best teams from the region will be selected.

For online competition:

- All teams welcome, TPF encouraged but not required.
- Teams must submit a TDP when they submit their preliminary video package.
  - There will be a **best** TDP award. You may update your TDP for the best TDP award at any time up until June 27th.

Team Description Paper

Download new template here!

- Improvements
- Scientific Publications
- System Description
  - Hardware
  - Software
  - Communications
  - Human-Robot Interface
- Application
  - Set-up and Break-down
  - Mission Strategy
  - Experiments
  - Application in the Field
- Team Members and Contributions
- CAD Drawings
- Lists
  - Systems
  - Hardware components
  - Software
- References

Qualifying Videos

- By the TDP due date of March 4th, all teams must submit videos, no more than one in-person competition year old (2019 is valid for this year), of a robot performing in at least **two** of the following tests (must be from different suites).
  - Dexterity: Non-Contact Linear Inspect
  - Maneuvering: MAN2: Align (linear rails)
  - Mobility: (**We prefer you build MOB3 if at all possible Note: do not perform both for qualification**)
    - MOB1: Variable Height Rails (new)

      OR
    - MOB3: K-Rail Crossover Slope (teams may elect to build just the center section)
  - Mapping: A hallway with one or two rooms and containing **at least 5 half** fiducials visible on their map. At least one set of fiducials must line up on either side of a wall and be shown on the resulting map as a completed circle to demonstrate good localization.
- Teams do NOT need to use the same robot or scale that they will compete with - we know that the robot will change anyway. This is to demonstrate the team's ability.
- New teams who do not have a working robot may elect to skip this requirement and be judged only on their TDP but team members/organization must not have competed before.

Video Requirements

- The entire test should be in one take, no cuts/edits.
- The robot should be clear enough to verify that it is of the same configuration (no components added/removed). The apparatus should be clear enough to verify that it is of the correct settings and dimensions.
  - The (uncut) video can start or end with a brief tour of the robot and apparatus if it is difficult to get an angle that shows this during the test.
- Videos from the four views should be merged into a time-synchronized quad-screen.
  - This can be done live via a video processing module (e.g. using a quad-box), live in software (e.g. using OBS Studio or a video conferencing program), or afterwards from several cameras.
  - See https://rrl.forum.robocup.org/t/video-recording-processing-procedure-hints/54 for an example of a suitable process for merging videos from multiple cameras using the free FFmpeg program.

Qualifying Video Format

TASK DETAIL

ROBOT/INTERFACE VIEW

SHOW AS MUCH DETAIL OF THE TASK AS POSSIBLE

SAVE SCREEN TO VIDEO OR ZOOM IN WITH CAMERA AS SHOWN HERE

SHOW THE OPERATOR IN THE BACKGROUND WITH BACK TOWARD THE APPARATUS

SHOW EASILY READABLE TIMESTAMP, PRINTED TRIAL INFO, AND ALL OPERATOR ACTIONS

OVERVIEW OF ROBOT & OPERATOR

ALL OPERATOR ACTIONS

One Option…

- Use tripod mounted cameras for robot overviews and task details.
- Use this apparatus to mount a camera over the operator interface.

PARTS LIST

A [QTY 1] 5 x 10 x 90 cm (2 x 4 x 36 in) HORIZONTAL RAIL

B [QTY 2] 5 x 10 x 40 cm (2 x 4 x 16 in) SIDE ARMS

C [QTY 1] 10 x 10 x 60 cm (4 x 4 x 24 in) POST WITH 45° TOP

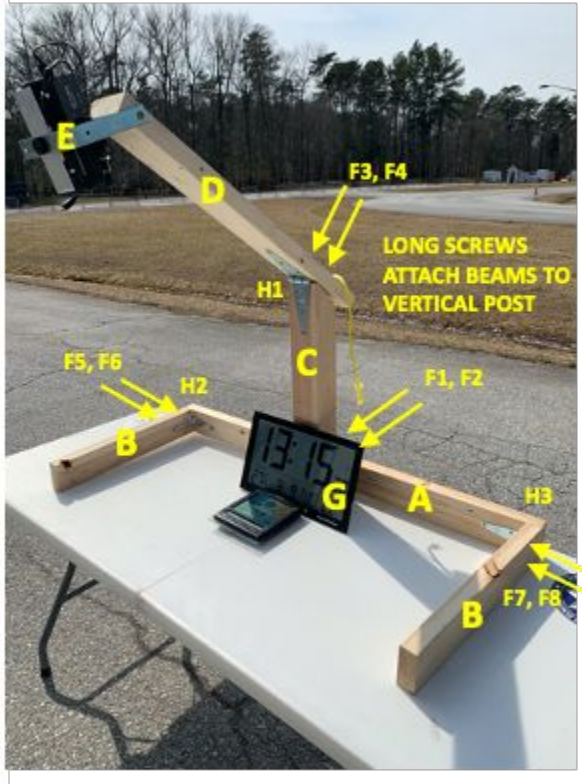
D [QTY 1] 5 x 10 x 60 cm (2 x 4 x 24 in) CAMERA ARM

E [QTY 1] 15 x 15 cm (6 x 6 in) angle bracket,
[QTY 1] Washer head screw, and
[QTY 1] Threaded screw for camera mount

F [QTY 20] short screws 35 mm (1-1/2 in) length,
[QTY 6] long screws 100 mm (4 in) length

G [QTY 2] Time-synced clock with 10 cm (4 in) numbers

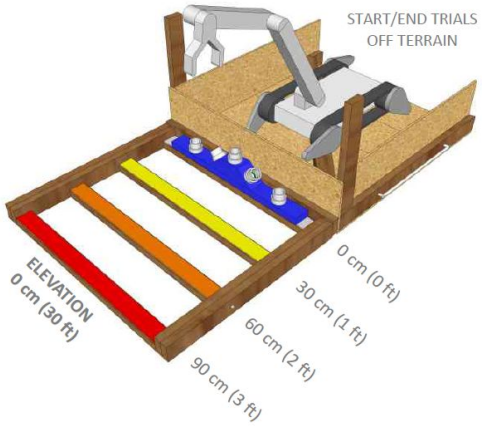
H [QTY 3] Optional hinges to enable folding and stowing
[QTY 1] Optional strap or rope to secure camera arm upright



Qualifying Videos

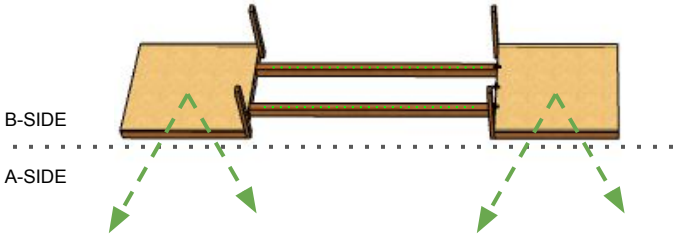
Dexterity:

Non-Contact Linear Inspect



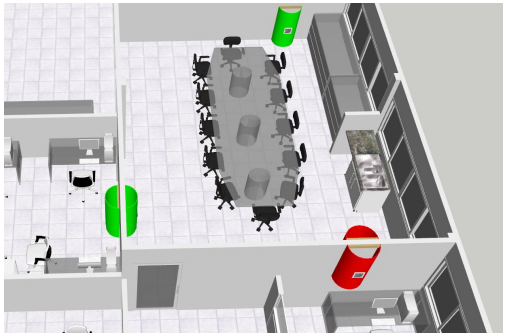
Maneuvering:

MAN2: Align (linear rails)



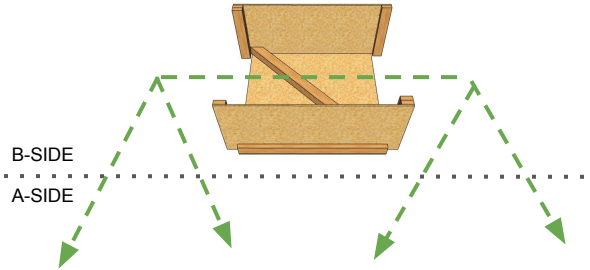
Mapping:

A hallway with one or two rooms and containing at least 5 (half-)fiducials visible on their map.



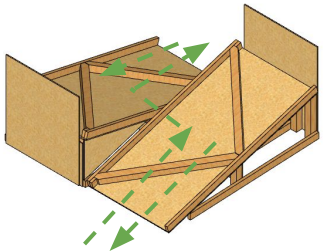
Mobility:

MOB1: Variable Height Rails



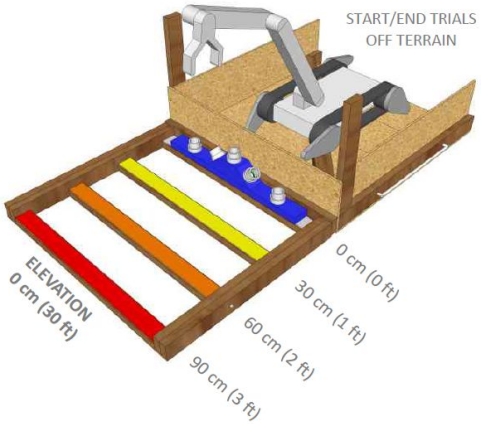
OR

MOB3: K-Rails on Crossover Slope



A Note on Build

- Dimensions:
  - This document specifies lumber dimensions that are commonly available in some countries.
    - “5 x 10 cm “ and “10 x 10 cm” lumber in some Metric countries (which is actually 5 x 10 cm and 10 x 10 cm).
    - “2 x 4 in” and “4 x 4 in” dimensional lumber in the US (which is actually 1.5 x 3.5 in and 3.5 x 3.5 in).
  - For countries where lumber is not widely available in such dimensions, it is acceptable to substitute lumber of the closest available dimensions. This may require other dimensions to be adjusted to fit.
- Heavy vs Light Apparatuses:
  - The “Heavy” builds mentioned in this document conform to the standard (or prototypical standard) test methods. We highly recommend building these if possible.
  - We recognise that due to the pandemic, there may be limited time, space, or materials available. In some cases, we have included “Light” options that, in some situations, may be sufficient for qualification and/or for remote online competition. These are marked accordingly.
- These instructions are *ONLY* for qualification! Teams wishing to participate in the remote online competition will also need to build additional apparatuses. Watch the mailing list for announcements about the rulebook and construction guide.



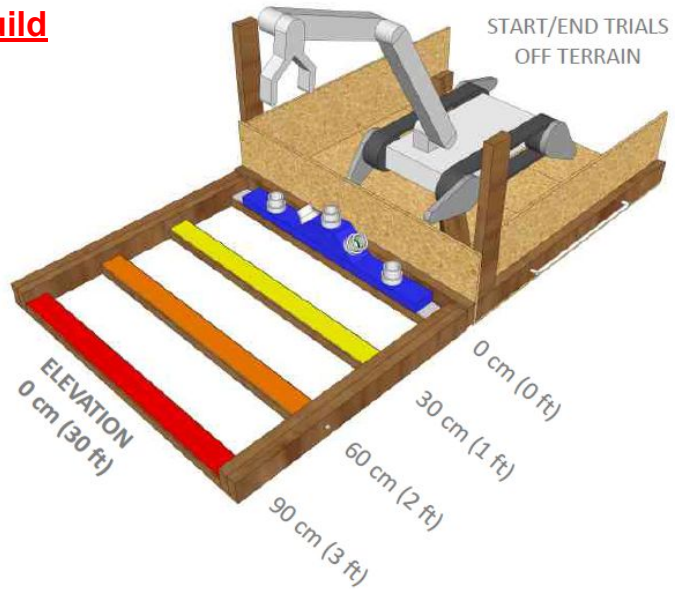
Video Qualifications

Dexterity: Non-Contact Linear Inspect

- Section 1 - How to build the apparatus
  - Assembly guide
- Section 2 - How to perform the test
  - Form

Video Qualifications

Dexterity: Non-Contact Linear Inspect - **How to build the test- Heavy Build**



PURCHASE LIST:

- ❑ [2] 120 x 120 cm (48 x 48 in) shelving wood for walls and floor pieces
- ❑ [15] 5x10x240cm (2x4x96in)lumber rails
- ❑ [1] 10x10x240cm (4x4x96in) lumber post
- ❑ [5] PVC Caps 5 cm dia (2 in dia)
  (https://www.ferguson.com/product/proflo-dwv-heavy-duty-high-pressure-pvc-cap-pftc/_/A-ProdFamily-115673)
- ❑ [1] 50 ID mm x 2400 mm (2 ID x 96 in) PVC Pipe
  https://www.amazon.com/PVC-Pipe-Sch-Inch-White/dp/B072Q9M54Z/
- ❑ [100] 40 mm (1-1/2 in) screws – torx/star bits preferred
- ❑ [50] 80 mm (3 in) screws - torx/star bits preferred
- ❑ [2] bolts with wing nuts approx. 12 mm x 130 mm (1/2 x 4 in)

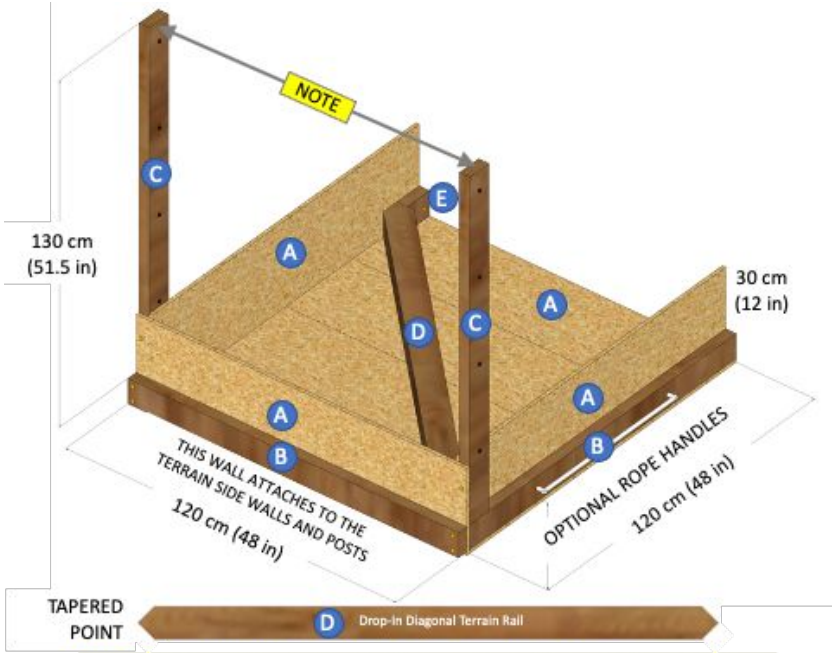
Note:
If you do not already have this apparatus built from past years and are having trouble getting materials and space together in time, **for qualification only** you may choose to build the light version shown later in this document.

Video Qualifications

Dexterity: Non-Contact Linear Inspect - **How to build the test-Heavy Build**

PARTS LIST:

- A [QTY 7] 30 x 120 cm (12 x 48 in) walls and floor pieces can be made from purchased shelving of any thickness. Or cut from a plywood sheet with the floor being one square piece.
- B [QTY 3] 5 x 10 x 120 cm (2 x 4 x 48 in) horizontal beams at the base of each wall attaches to the floor with screws up from underneath. This also holds multiple flooring pieces together.
- C [QTY 2] 5 x 10 x 130 cm (2 x 4 x 51.5 in) posts hold the front of the shelf in place at all elevations. They have a hole pattern every 30 cm (12 in) to attach the shelf with bolts and wing nuts.
- D [QTY 1] 10 x 10 x ~157 cm (4 x 4 x ~62 in) drop-in diagonal rail should be cut to fit because it depends on the thickness of your walls and side rails. So measure the diagonal length then cut. Note that this diagonal rail has pointed tapers on both ends to drop into place.
- E [QTY 1] 5 x 10 x 10 cm (2 x 4 x 4 in) block holds the drop-in diagonal rail in place. It should be affixed to the side wall so the drop-in diagonal rail can be easily removed vertically.



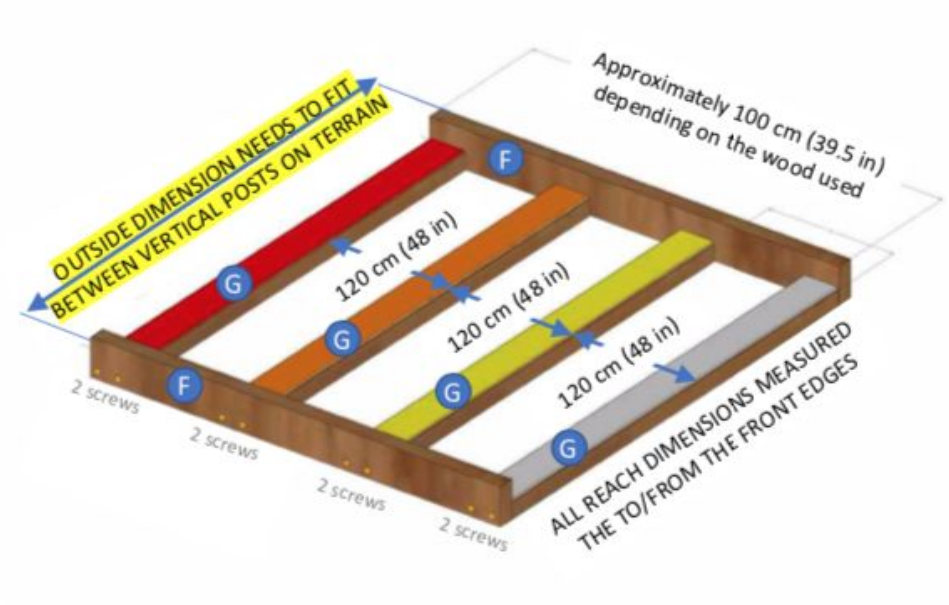
NOTE: The task shelf frame NEEDS to fit snugly between these posts to affix to them. So measure this dimension before fabricating the task shelf.

Video Qualifications

Dexterity: Non-Contact Linear Inspect - **How to build the test-Heavy build**

PARTS LIST:

- F [QTY 2] 5 x 10 x 100 cm (2 x 4 x 39.5 in) or longer side beams to affix the transverse slats shown in colors by reach distance.
- G [QTY 4] 5 x 10s (2 x 4s) cut to size as measured so the OUTSIDE DIMENSION OF THE OVERALL SHELF ASSEMBLY FITS INSIDE THE TERRAIN POSTS. These transverse slats hold the dexterity tasks in place. Use two screws on both ends to ensure they do not rotate.

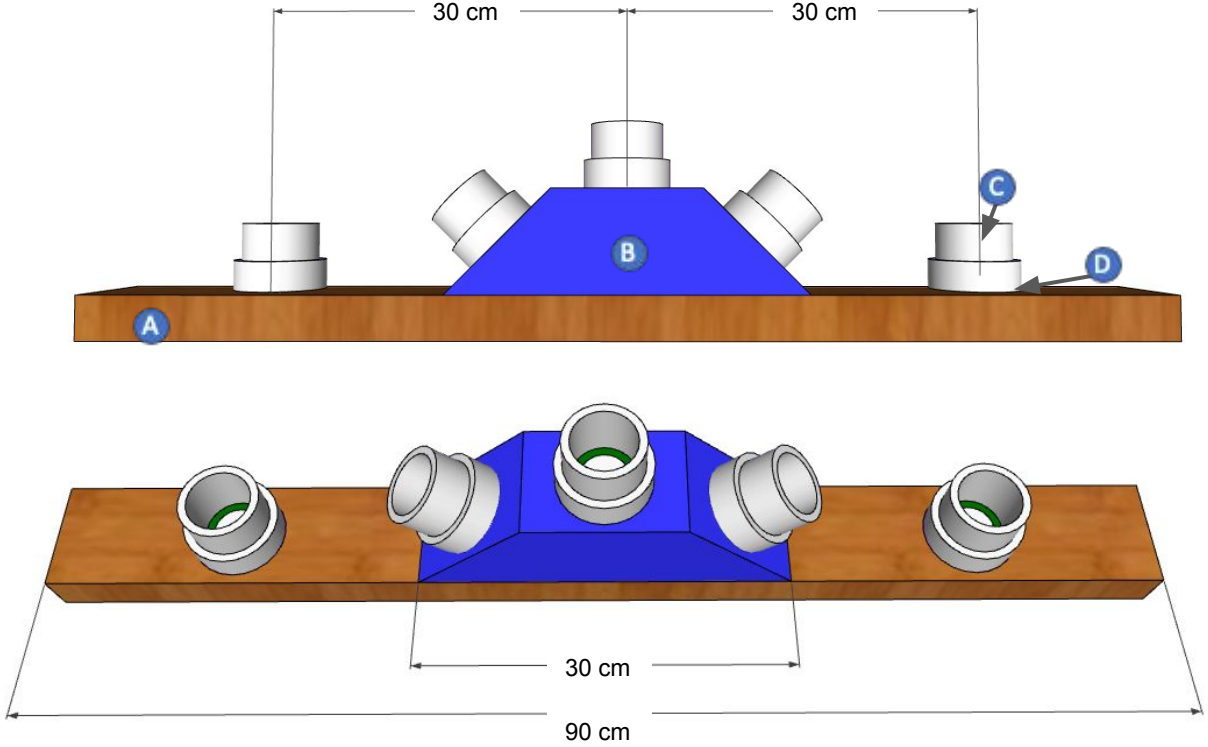


Video Qualifications

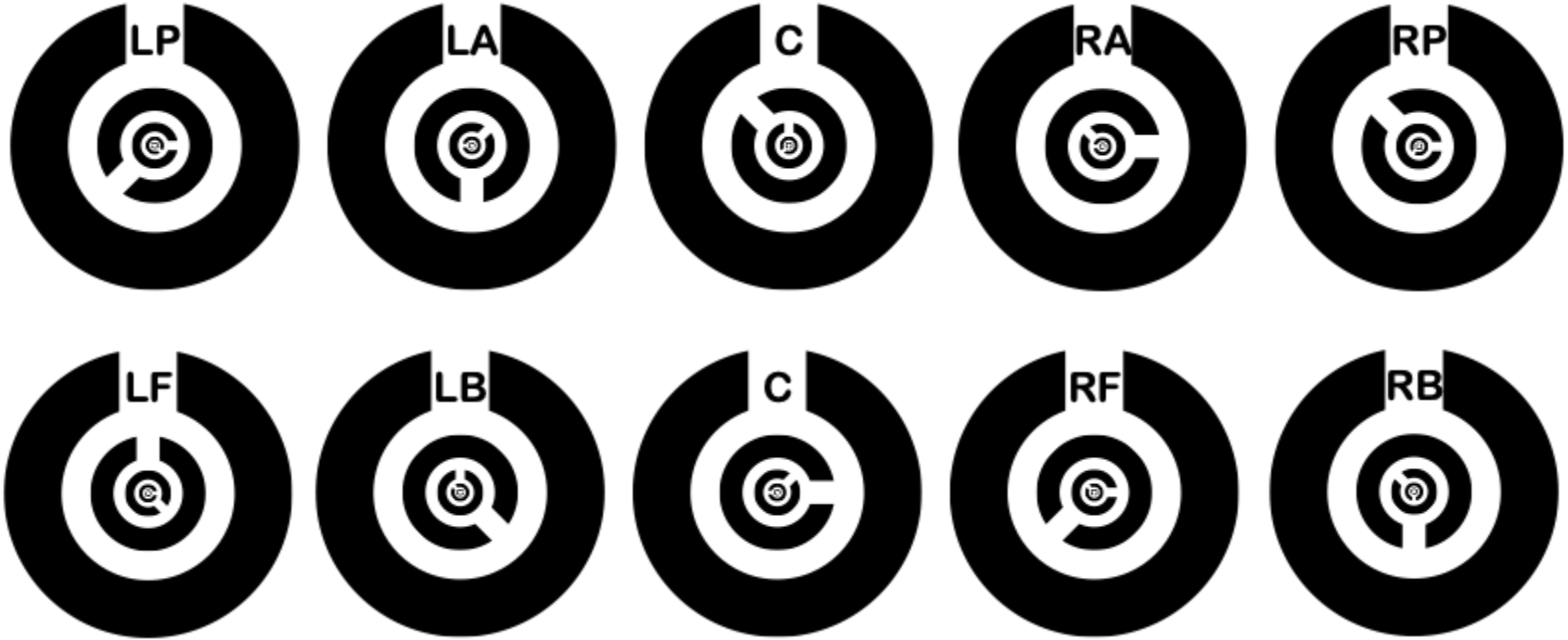
Dexterity: Non-Contact Linear Inspect - **How to build the test (for both light and heavy build)**

Parts List:

- A [1] 5 x 10 x 90 cm (2 x 4 x 36 in) Lumber
- B [1] 10 x 10 x 30 cm (4 x 4 x 12 in) Lumber
- C [5] 50 ID mm x 50 mm (2 ID x 2 in) Pipe
- D [5] 50 mm (2in) Pipe caps



NOTE: The inner edge of the largest ring should be 55 mm (2.2 in)



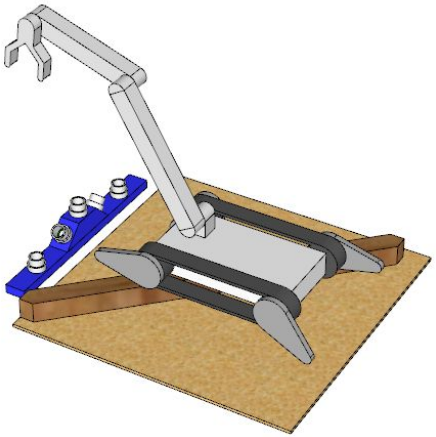
Video Qualifications

Dexterity: Non-Contact Linear Inspect - **How to build the test- Light build**

PURCHASE LIST:

- ❑ [1] 120 x 120 cm (48 x 48 in) shelving wood for walls and floor pieces
- ❑ [1] 10 x 10 x 240cm (4 x 4 x 96in) lumber post
- ❑ [5] PVC Caps 5 cm dia (2 in dia) (https://www.ferguson.com/product/proflo-dwv-heavy-duty-high-pressure-pvc-cap-pftc/_/A-ProdFamily-115673)
- ❑ [1] 50 ID mm x 2400 mm (2 ID x 96 in) PVC Pipe https://www.amazon.com/PVC-Pipe-Sch-Inch-White/dp/B072Q9M54Z/
- ❑ [100] 40 mm (1-1/2 in) screws – torx/star bits preferred
- ❑ [50] 80 mm (3 in) screws - torx/star bits preferred
- ❑ [2] bolts with wing nuts approx. 12 mm x 130 mm (1/2 x 4 in)
- ❑ (Optional) Blocks, boxes, etc. to raise task rail to desired height

Task rail and floor piece should be secured so they do not move relative to each other during the test.



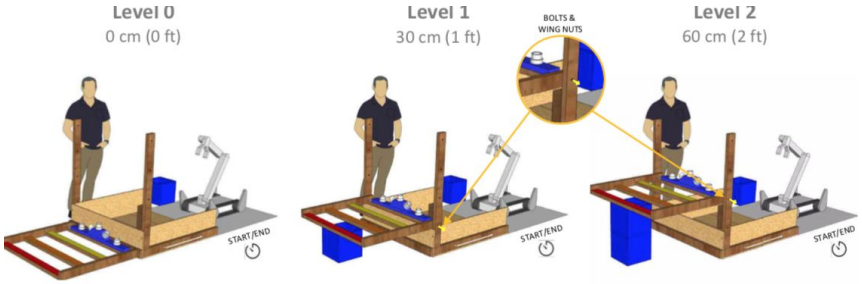
Note:

For the qualification video we only need to see the robot performing the Linear Inspection task horizontally at a single distance and height that the team nominates. As long as the video clearly shows the robot staying on the terrain (not past the front of the diagonal beam or falling off the sides of the terrain), the team may build the Light apparatus shown here.

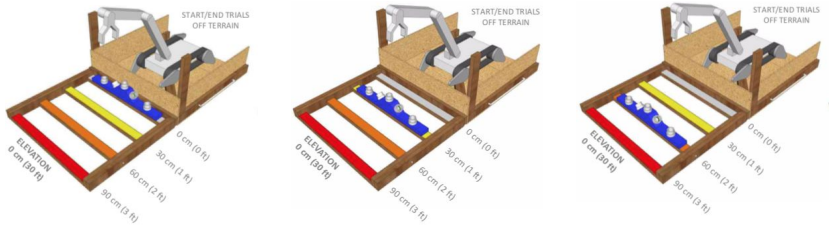
Video Qualifications

Dexterity: Non-Contact Linear Inspect - **How to perform the test(Regardless of the build)**

1. Choose your height and offset. Note on form.
2. Set timer for 10 minutes
3. Start robot outside of the apparatus
4. Robot traverses across the diagonal beam
5. Robot performs the inspection of the linear rail in the order as shown
   a. Align with the 5 cm (2 in) diameter pipe so the inner edge of the largest visual acuity ring is completely visible. The targets can be downloaded and printed on paper or sticker sheets.
   b. Each pipe has 5 increasingly small ring gaps to identify based on their orientations (random combinations of 8 orientations).
   c. Score up to 5 points per task = 25 points total:
      i. 1 point for successful alignment with the outer ring showing the gap oriented to the Top (always).
      ii. 1 point for each smaller gap orientation identified correctly.
6. Robot traverses back across the diagonal beam and out of the apparatus



Choose Height

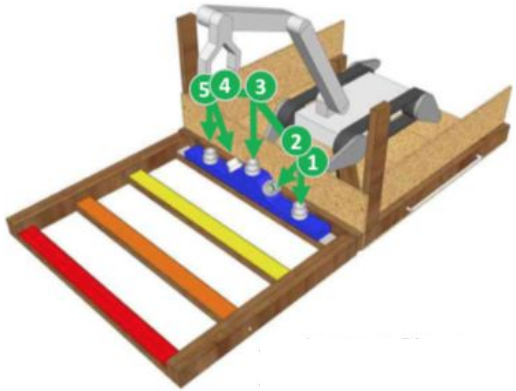


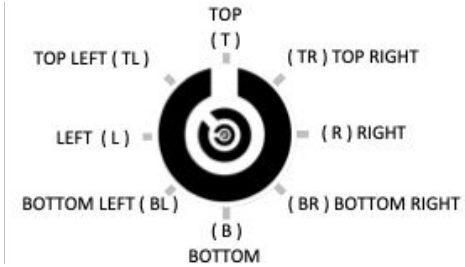
Choose Offset

Video Qualifications

Dexterity: Non-Contact Linear Inspect - **How to perform the test(Regardless of the build)**

1. Choose your height and offset.
2. Set timer for 10 minutes
3. Start robot outside of the apparatus
4. Robot traverses across the diagonal beam
5. Robot performs the inspection of the linear rail in the order as shown
   a. Align with the 5 cm (2 in) diameter pipe so the inner edge of the largest visual acuity ring is completely visible. The targets can be downloaded and printed on paper or sticker sheets.
   b. Each pipe has 5 increasingly small ring gaps to identify based on their orientations (random combinations of 8 orientations).
   c. Score up to 5 points per task = 25 points total:
      i. 1 point for successful alignment with the outer ring showing the gap oriented to the Top (always).
      ii. 1 point for each smaller gap orientation identified correctly.
6. Robot traverses back across the diagonal beam and out of the apparatus





TRIAL INFO

Example Linear Test Form

COUNTRY:

ORGANIZATION:

CITY:

TRIAL DATE:

ROBOT MAKE:

ROBOT MODEL:

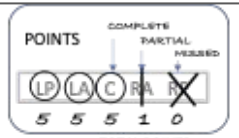
OPERATOR:

SIGNATURE

ELEVATION
(CHOOSE ONE)

- ❑ 0 cm (0 ft)
- ❑ 30 cm (1 ft)
- ❑ 60 cm (2 ft)
- ❑ 90 cm (3 ft)

Only pick one for Qualification



ROUND TIME TO NEAREST 0.25 MINUTES (15 SECONDS)

			TOTAL POINTS		ELAPSED TIME		TASK RATE
START (2400): _____ END (2400): _____ ELAPSED (MIN:SEC): _____	LP LA C RA RP	OF 25	+	DECIMAL MIN	=	
START (2400): _____ END (2400): _____ ELAPSED (MIN:SEC): _____	LP LA C RA RP	OF 25	+	DECIMAL MIN	=	
START (2400): _____ END (2400): _____ ELAPSED (MIN:SEC): _____	LP LA C RA RP	OF 25	+	DECIMAL MIN	=	
START (2400): _____ END (2400): _____ ELAPSED (MIN:SEC): _____	LP LA C RA RP	OF 25	+	DECIMAL MIN	=	

Notes:

Video Qualifications

Maneuvering:

MAN2:Align (linear rails)

- Section 1 - How to build the apparatus
  - Assembly guide
- Section 2 - How to perform the test
  - Form

Video Qualifications

Maneuvering:MAN2:Align (linear rails) - How to build the test - Heavy Build

PURCHASE LIST:

- ❏ [2] 120 x 120 cm (48 x 48 in) shelving wood for floor
- ❏ [2] 10 x 10 x 240cm (4 x 4 x 96 in) lumber rails
- ❏ [6] 5 x 10 x 240 cm (2 x 4 x 96 in) lumber post
  - ❏ **Note: you may use pallets for the subfloor structure to lessen the amount of lumber needed. The top surface should be a solid surface and flush with the rails.**
- ❏ [50] 80 mm (3 in) screws - torx/star bits preferred
- ❏ [4] 10 cm (4 in) L brackets to attach rails to raised subfloor

Note:
If you do not already have this apparatus built from past years and are having trouble getting materials and space together in time, **for qualification only** you may choose to build the light version shown later in this document.

Video Qualifications

Maneuvering:MAN2:Align (linear rails) - How to build the test-Heavy Build

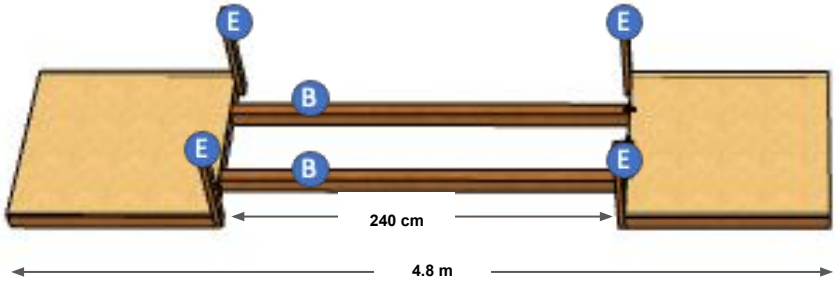
PARTS LIST:

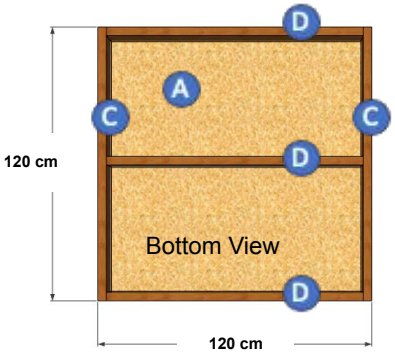
- A [2] 120 x 120 cm (48 x 48 in) shelving wood for floor
- B [2] 10 x 10 x 240 cm (4 x 4 x 96in) lumber rails

  Note: Dimensions of the rails and setting the separation distance of the rails to match the overall width of the robot's ground contacts as shown.
- C [4] 5 x 10 x 120 cm (2 x 4 x 48 in) lumber post
- D [6] 5 x 10 x 110cm (2 x 4 x 45 in) lumber post
- E [4] 5 x 10 x 60 cm (2 x4 x 24 in) lumber post

[50] 80 mm (3 in) screws - torx/star bits preferred

[4] 10 cm (4 in) L brackets to attach rails to raised subfloor





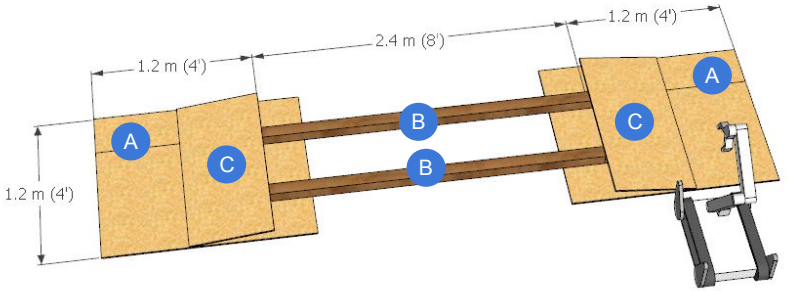
Note:
If you do not already have this apparatus built from past years and are having trouble getting materials and space together in time, **for qualification only** you may choose to build the light version shown later in this document.

Video Qualifications

Maneuvering:MAN2:Align (linear rails) - How to build the test-Light Build

PARTS LIST:

- ❑ A [2] 120 x 150 cm (48 x 60 in) shelving wood for floor
- ❑ B [2] 10 x 10 x 260cm (4 x 4 x 104 in) lumber rails, ends cut at 45º
- ❑ C [2] 30 x 120 cm (12 x 48 in) shelving wood for ramps
- ❑ [12] 80 mm (3 in) screws - torx/star bits preferred



Attach rails to floor panels from below using screws.
Screw through ramps to the ends of the rails.

For qualification *ONLY*, to save time and space the team may build one of the “Light” apparatuses on this page as long as:

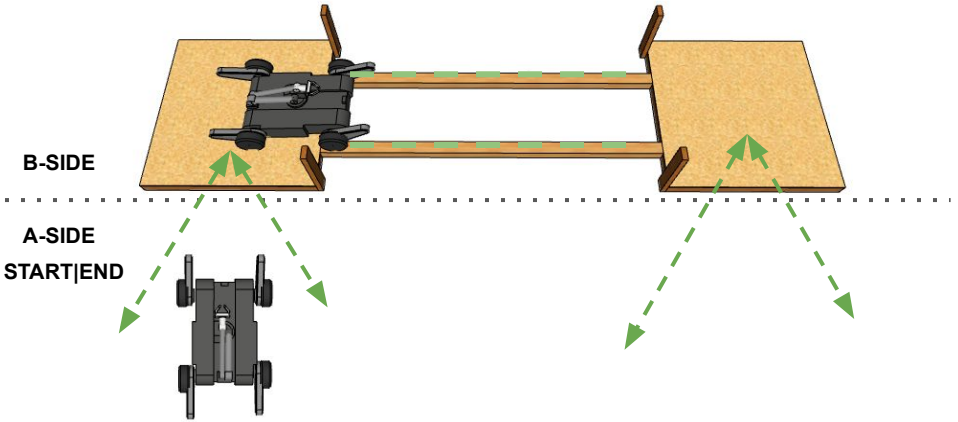
- The team is satisfied that the additional step to get on and off the rails at each end will not disadvantage them.
- The robot is light enough to not damage the ramps.
- The video clearly shows the robot staying on the apparatus and, in particular, not violating the front corners.

For the remote online competition, the team must build the “Heavy” apparatus shown on the previous slides.

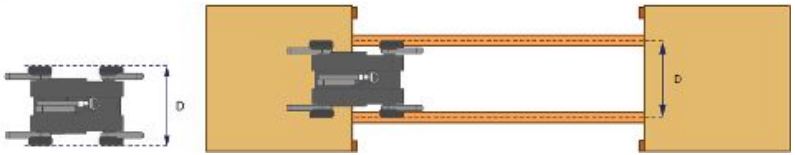
Video Qualifications

Maneuvering: MAN2:Align (linear rails) - How to perform the test (Regardless of the build)

1. Set the width of the rails.
   a. Note: Dimensions of the rails and setting the separation distance of the rails to match the overall width of the robot's ground contacts as shown.
2. Start robot on the A-Side
3. Set timer for 10 minutes
4. Traverse **forward** from A-Side to B-Side
5. Remotely align robot with rails
6. Traverse across the beams
7. Traverse **forward** from B-Side to A-Side
8. Traverse in **reverse** from B-Side to A-Side
9. Remotely align robot with rail
10. Traverse across the beams
11. Traverse in **reverse** from B-Side to A-Side
12. Repeat until timer elapses



Perform the Task



Set Dimensions of Rails

NOTE: If your robot has different ground contact widths at the front and back (e.g. you only have flippers at one end, or you have a tricycle arrangement), the rails should be arranged (and/or added) so that a misalignment of approximately 5 cm (2 in) will cause the robot to fall between the rails. Contact the RRL Committee (rescue.robot.league@nist.gov) for any questions.

Example Align (linear rails) Test Form

TRIAL INFO

COUNTRY: _____

ORGANIZATION: _____

CITY: _____

TRIAL DATE: _____

ROBOT MAKE: _____

ROBOT MODEL: _____

OPERATOR: _____

SIGNATURE _____

REPETITIONS
(NOTE TIME WHEN FAULT OR ADMIN PAUSE IS DECLARED)

☐ 1 _____	☐ 11 _____	☐ 21 _____
☐ 2 _____	☐ 12 _____	☐ 22 _____
☐ 3 _____	☐ 13 _____	☐ 23 _____
☐ 4 _____	☐ 14 _____	☐ 24 _____
☐ 5 _____	☐ 15 _____	☐ 25 _____
☐ 6 _____	☐ 16 _____	☐ 26 _____
☐ 7 _____	☐ 17 _____	☐ 27 _____
☐ 8 _____	☐ 18 _____	☐ 28 _____
☐ 9 _____	☐ 19 _____	☐ 29 _____
☐ 10 _____	☐ 20 _____	☐ 30 _____

COMPLETENESS SCORE

TOTAL REPETITIONS

of _____

RELIABILITY

(TOTAL REPS / ATTEMPTED) X 100

%

EFFICIENCY

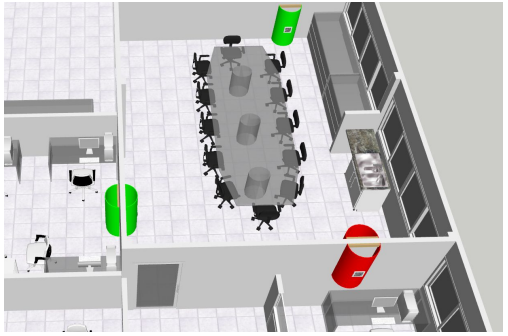
TOTAL REPS / MINUTES

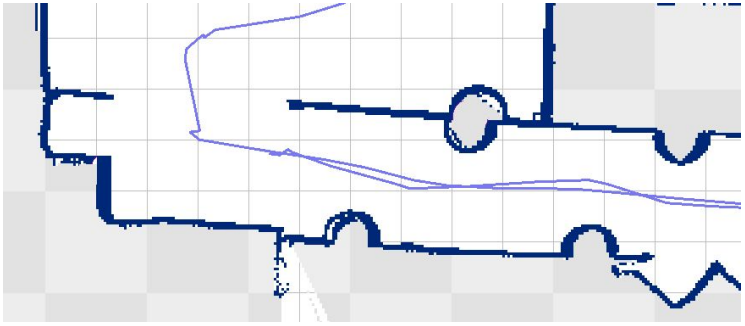
RATE

RAIL WIDTH:_____cm

Time: 10 minutes

Notes:





Video Qualifications

Mapping:

A hallway with one or two rooms and containing at least 5 (half-)fiducials visible on their map.

- Section 1 - How to build the apparatus
  - Assembly guide
- Section 2 - How to perform the test
  - Form

Video Qualifications

Mapping - How to build the test

A hallway with one or two rooms and containing **at least 5 half** fiducials visible on their map. At least one set of fiducials must line up on either side of a wall and be shown on the resulting map as a completed circle to demonstrate good localization.

PURCHASE LIST:

- (A) [10] 5x10x 240 cm (2x4x96 in) post
- (B) [3] 60 ID x 120 cm Concrete Forms

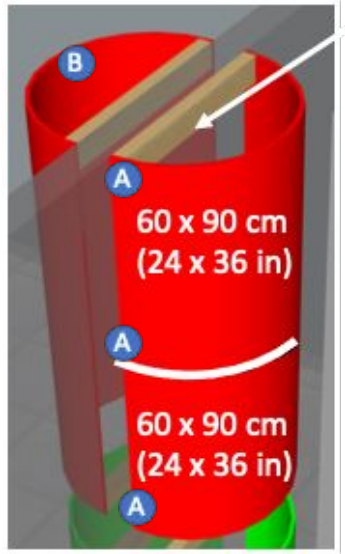
Or

- ❏ [5] Panels to make 5 half-cylinders at least 40 cm (16 in) diameter x at least 90 cm (36 in) tall (ideally 60 cm (24 in) diameter and 120 cm (48 in) tall)

  Note: Any material can be used to make the mapping fiducials, the material must be smooth and able to hold a cylindrical shape. The length of the fiducial can be adjusted to material available in your local area. However, the total length must be greater than 90 cm and the overall diameter no less than 40 cm when paired together.

- ❏ [5] Printed QR codes (all the same or all unique) each version 1 (21x21 squares), level L error correction (lowest, the default for the ZXing library), 20 cm (8 in) in size (excluding white border).

Wood beam on top, middle, and bottom maintains the diameter and enables hanging.
The middle beam is be shared by both the upper and lower panels.
Bend the panels as smoothly possible



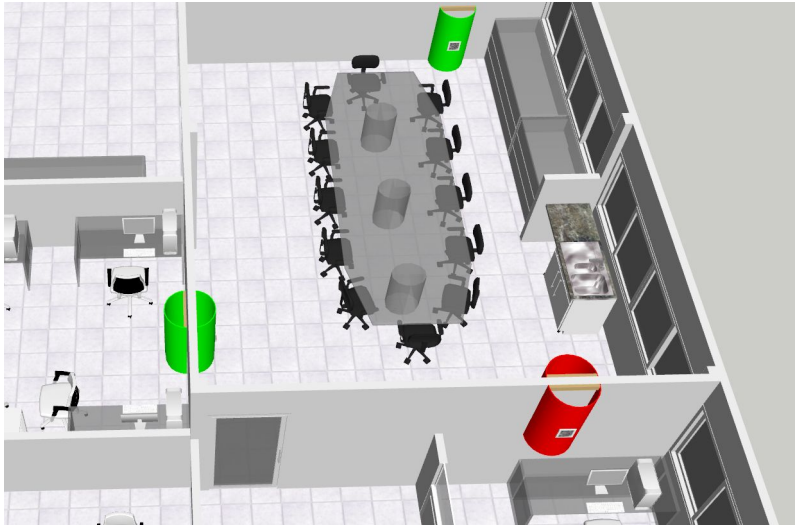
Video Qualifications

Mapping - How to perform the test

A hallway with one or two rooms and containing **at least 5 half** fiducials visible on their map. At least one set of fiducials must line up on either side of a wall and be shown on the resulting map as a completed circle to demonstrate good localization.

1. Hang fiducials thru your environment.
   a. They may be all at the level of your laser scanner for 2D mapping, or at two different heights if your system does 3D mapping.
   b. At least one set of fiducials must line up on either side of a wall while not both being visible from any one location, and be shown on the resulting map as a completed circle to demonstrate good localization.

2. Attach QR codes (all the same or all unique) to each fiducial.



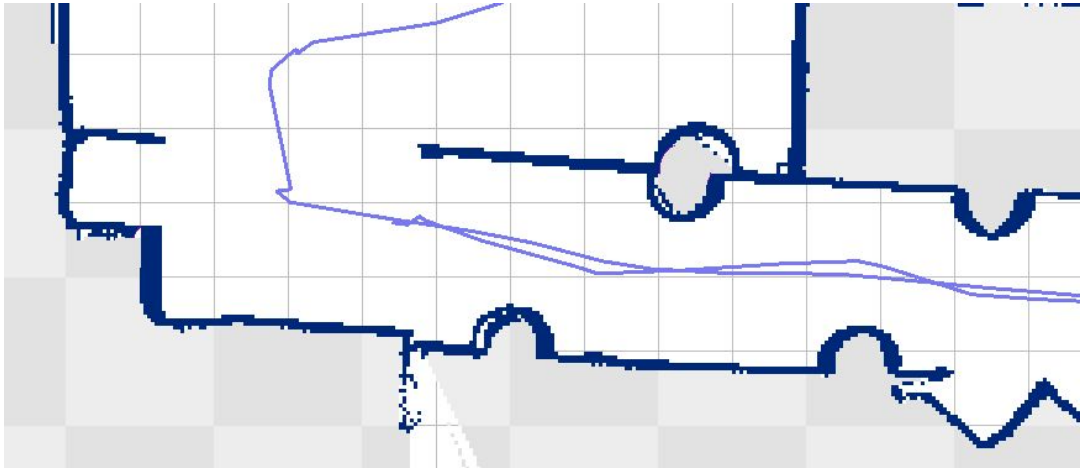
Video Qualifications

Mapping - How to perform the test

A hallway with one or two rooms and containing **at least 5 half** fiducials visible on their map. At least one set of fiducials must line up on either side of a wall and be shown on the resulting map as a completed circle to demonstrate good localization.

An example section of a map satisfying this criteria:

- Contains 5 clearly visible half fiducials.
- At least two line up across a wall and would form a complete circle (plus thickness of wall) if the map is correct.
    - We realize you may not have your final map implementation tuned yet so this doesn't need to be perfect.
- Map file follows the GeoTIFF standard and QR codes are noted in a text file (see 2019 rulebook for details).
    - https://rrl.robocup.org/wp-content/uploads/2019/06/rrl_rulebook_2019_v2.4.pdf



TRIAL INFO

Example Mapping Test Form

COUNTRY:

ORGANIZATION:

CITY:

TRIAL DATE:

ROBOT MAKE:

ROBOT MODEL:

OPERATOR:

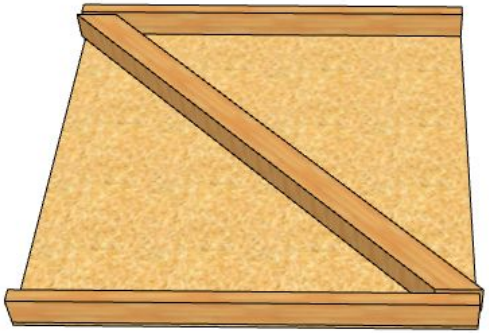
SIGNATURE

Map Metrics:

- ❑ Coverage (how many of fiducials are visible?)
- ❑ Local Accuracy (by room)
- ❑ Global accuracy (average overall)

Submit the following:

- ❑ GeoTiff file
- ❑ Text file of QR code**s**



Video Qualifications

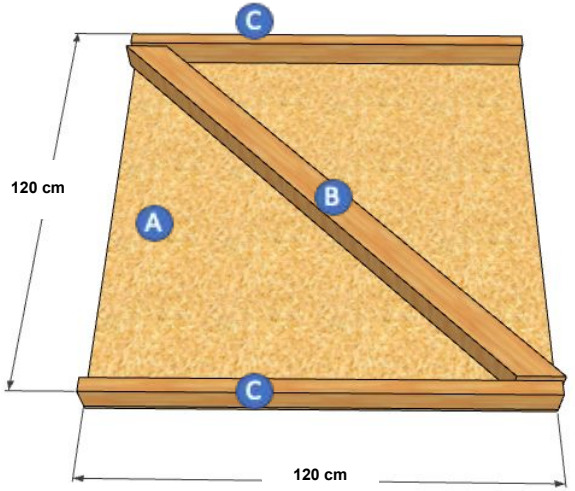
Mobility:

MOB1: Variable Height Rails

- Section 1 - How to build the apparatus
  - Assembly guide
- Section 2 - How to perform the test
  - Form

Video Qualifications

Mobility:MOB1:Variable Height Rails - How to build the test



PURCHASE LIST:

- ❏ [1] 120 x 120 cm (48 x 48 in) shelving wood for floor
- ❏ [1] 10 x 10 x 240 cm (4 x 4 x 96 in) lumber rail
- ❏ [1] 5 x 10 x 240 cm (2 x 4 x 96) lumber post
- ❏ [10] 80 mm (3 in) screws - torx/star bits preferred

PARTS LIST:

- (A) [1] 120 x 120 cm (48 x 48 in) shelving wood for floor
- (B) [1] 10 x 10x~165cm (4 x 4 x~65 in) lumber rail (Note: Measure the diagonal length then cut. Diagonal rail has 45 degree tapers on opposite ends)
- (C) [2] 5 x 10 x 240 cm 92 x 4 x 48) lumber post

[10] 80 mm (3 in) screws - torx/star bits preferred

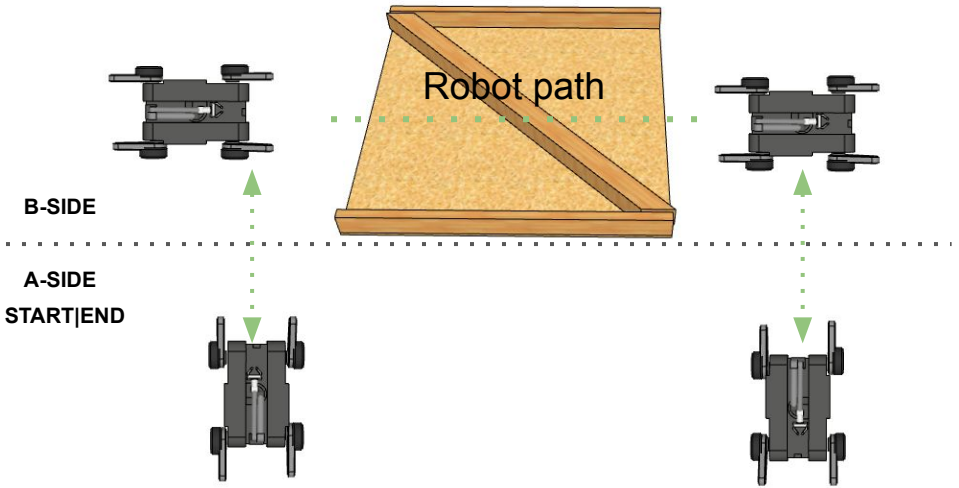
Note:Obstacle should not move while driving over. Attach to solid structure as needed.

Video Qualifications

Mobility:MOB1:Variable Height Rails - How to perform the test

1. Start robot on the A-Side
2. Set timer for 10 minutes
3. Traverse **forward** from A-Side to B-Side
4. Traverse across the beam following the prescribed path **without** touch the side rails
5. Traverse **forward** from B-Side to A-Side
6. Traverse in **reverse** from B-Side to A-Side
7. Traverse across the beam
8. Traverse in **reverse** from B-Side to A-Side
9. Repeat until timer elapses

Note: Robot must traverse over the rail on a 45 degree angle.



Example Variable Height Rail Test Form

TRIAL INFO

COUNTRY: _____

ORGANIZATION: _____

CITY: _____

TRIAL DATE: _____

ROBOT MAKE: _____

ROBOT MODEL: _____

OPERATOR: _____

SIGNATURE _____

---------- REPETITIONS ----------
(NOTE TIME WHEN FAULT OR ADMIN PAUSE IS DECLARED)

☐ 1 _____	☐ 11 _____	☐ 21 _____
☐ 2 _____	☐ 12 _____	☐ 22 _____
☐ 3 _____	☐ 13 _____	☐ 23 _____
☐ 4 _____	☐ 14 _____	☐ 24 _____
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☐ 7 _____	☐ 17 _____	☐ 27 _____
☐ 8 _____	☐ 18 _____	☐ 28 _____
☐ 9 _____	☐ 19 _____	☐ 29 _____
☐ 10 _____	☐ 20 _____	☐ 30 _____

COMPLETENESS SCORE

TOTAL REPETITIONS

of _____

RELIABILITY

(TOTAL REPS / ATTEMPTED) X 100

%

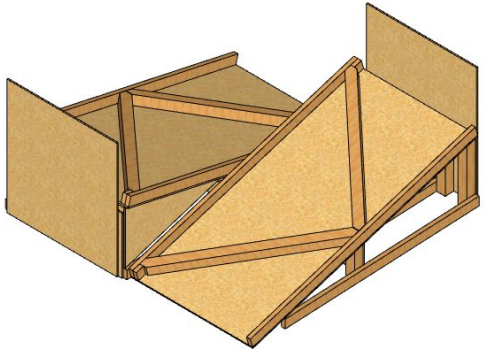
EFFICIENCY

TOTAL REPS / MINUTES

RATE

Time: 10 minutes

Notes:



Video Qualifications

Mobility:

MOB3: K-Rails on Crossover Slope

- Section 1 - How to build the apparatus
  - Assembly guide
- Section 2 - How to perform the test
  - Form

Video Qualifications

Mobility:MOB3:Crossover Slope on K Rails - How to build the test

PURCHASE LIST:

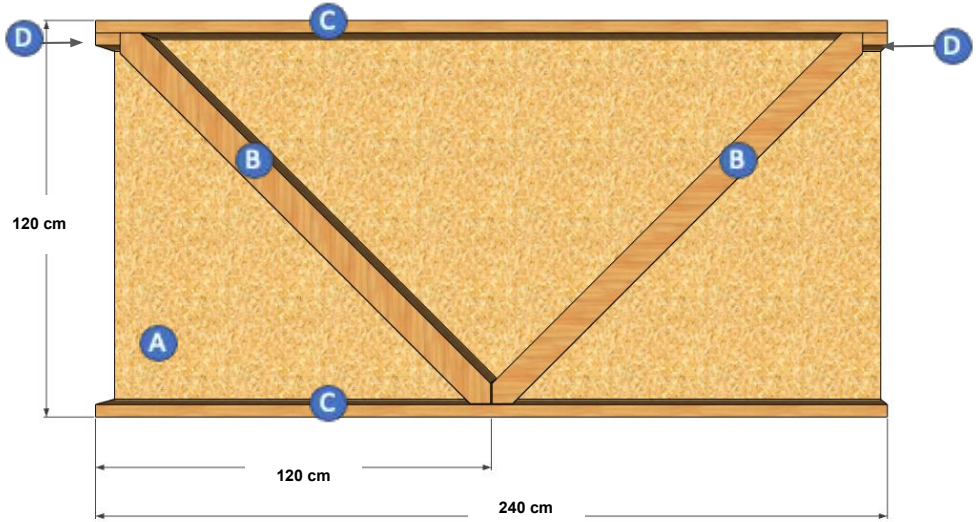
K-Rail Panels Only

- ❑ [2] 120 x 240 cm (48 x 96 in) shelving wood for floor
- ❑ [4] 10 x 10 x 240 cm (4 x 4 x 96 in) lumber rail
- ❑ [5] 5 x 10 x 240 cm (2 x 4 x 96 in) lumber post
- ❑ [50] 80 mm (3 in) screws - torx/star bits preferred

PARTS LIST:

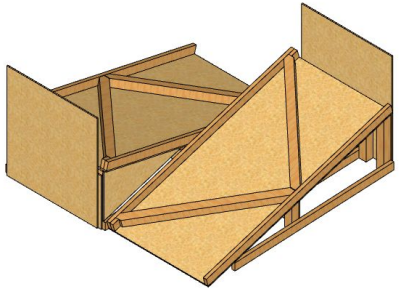
K-Rail Panels Only

- A [2] 120 x 240 cm (48 x 96 in) shelving wood for floor
- B [4] 10 x 10 x ~161.5 cm (4 x 4 x ~63 1/2 in) lumber rail
  (Note: Measure the diagonal length then cut. Diagonal rail has pointed 45 degree tapers on both ends)
- C [4] 5 x 10 x 240 cm (2 x 4 x 96 in) lumber post
- D [4] 5 x 10 x 8 cm (2 x 4 x 3 in) lumber post
- ❑ [50] 80 mm (3 in) screws - torx/star bits preferred



Video Qualifications

Mobility:MOB3:Crossover Slope on K Rails - How to build the test

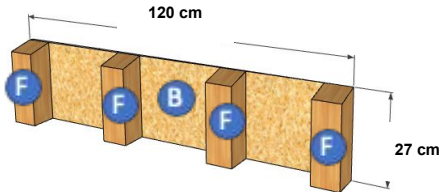


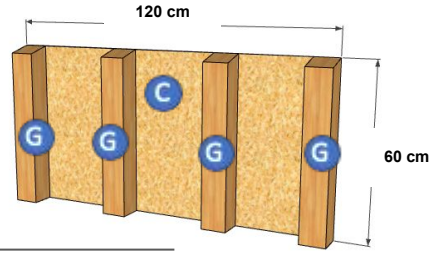
Note: Below is one way to support the panels. Fabrication of support structure can be accomplished several ways. Must be safe/strong enough to hold robot's weight. Must be at a 15 degree angle. You can also build this is 2 units so easier to handle.

PURCHASE LIST:

Underneath Structure Only

- ❑ [2] 120 x 240 cm (48 x 96 in) shelving wood for floor
- ❑ [2] 10 x 10 x 240 cm (4 x 4 x 96 in) lumber rail
- ❑ [6] 5 x 10 x 240 cm (2 x 4 x 96 in) lumber post
- ❑ [100] 80 mm (3 in) screws - torx/star bits preferred

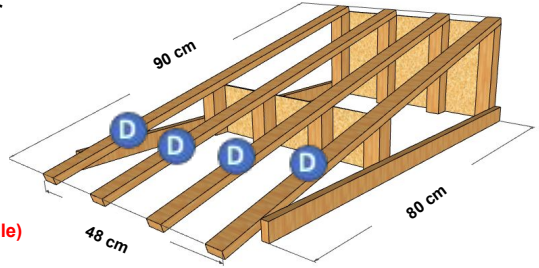


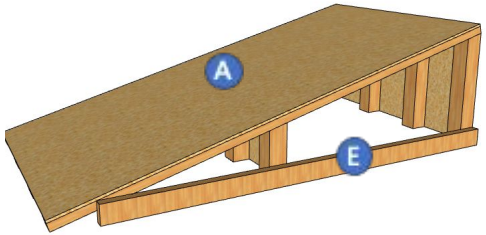


PARTS LIST:

Underneath Structure Only

- (A) [1] 120 x 230 cm (48 x 90 in) shelving wood for floor
- (B) [1] 27 x 120 cm (11 x 48 in) shelving wood
- (C) [1] 60 x 120 cm (23.5 x 48 in) shelving wood
- (D) [4] 5 x 10 cm x 230 cm (2 x 4 x 90 in) rail
- (E) [2] 5 x 10 cm x 205 cm (2 x 4 x 80 in) rail
- (F) [4] 10 x 10 x 27 cm (4 x 4 x 11 in) rail (cut on 15 degree angle)
- (G) [4] 10 x 10 x 60 cm (4 x 4 x 23.5 in) rail(cut on 15 degree angle)

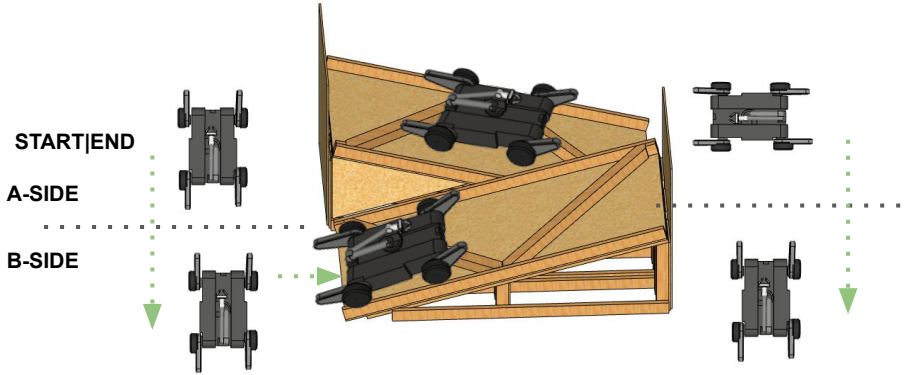




Video Qualifications

Mobility:MOB3:Crossover Slope on K Rails - How to perform the test

1. Start robot on the A-Side
2. Set timer for 10 minutes
3. Traverse **forward** from A-Side to B-Side
4. Traverse across the crossover slope
5. Traverse **forward** from A-Side to B-Side
6. Traverse in **forward or reverse** from B-Side to A-Side
7. Traverse across the crossover slope
8. Traverse in **forward or reverse** from B-Side to A-Side
9. Repeat until timer elapses



Example K-Rail Test Form

TRIAL INFO

COUNTRY: _____

ORGANIZATION: _____

CITY: _____

TRIAL DATE: _____

ROBOT MAKE: _____

ROBOT MODEL: _____

OPERATOR: _____

SIGNATURE _____

---------- REPETITIONS ----------
(NOTE TIME WHEN FAULT OR ADMIN PAUSE IS DECLARED)

☐ 1 _____	☐ 11 _____	☐ 21 _____
☐ 2 _____	☐ 12 _____	☐ 22 _____
☐ 3 _____	☐ 13 _____	☐ 23 _____
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☐ 6 _____	☐ 16 _____	☐ 26 _____
☐ 7 _____	☐ 17 _____	☐ 27 _____
☐ 8 _____	☐ 18 _____	☐ 28 _____
☐ 9 _____	☐ 19 _____	☐ 29 _____
☐ 10 _____	☐ 20 _____	☐ 30 _____

COMPLETENESS SCORE

TOTAL REPETITIONS

of _____

RELIABILITY

(TOTAL REPS / ATTEMPTED) X 100

%

EFFICIENCY

TOTAL REPS / MINUTES

RATE

Time: 10 minutes

Notes:

For More Info and Questions

- Please join our forum at https://rrl.forum.robocup.org to ask any general questions.
- For questions specific to your team, or to join our announcements mailing list, please email us at rescue.robot.league@nist.gov .
- Keep an eye on the website at https://rrl.robocup.org and https://2022.robocup.org for updates.
- Join our Facebook group https://www.facebook.com/groups/robocuprescue.
- To keep up to date with news across the RoboCup Federation, please email robocup-worldwide@lists.robocup.org.